

AMENDMENTS TO THE CLAIMS

This listing of claims replaces all prior versions, and listings, of claims in the application.

Claims 1-3 (Cancelled).

4. (Currently Amended) A wet etching apparatus for wet etching a high-k dielectric film, comprising:

a stage for holding a substrate supporting a film to be etched;

~~first ultraviolet radiating units~~ disposed opposite the stage, the first ultraviolet radiating units irradiating the high-k dielectric film with ultraviolet light having a wavelength not exceeding 200 nm for making the high-k dielectric film hydrophilic;

a chemical-solution coating unit for applying a coating of a liquid chemical solution to the high-k dielectric film that has been made hydrophilic, the liquid chemical solution including an etchant; and

~~second ultraviolet radiating units~~ disposed opposite the stage, the second ultraviolet radiating units irradiating the high-k dielectric film through the coating of the chemical solution with ultraviolet light having a wavelength longer than 200 nm for breaking bonds of molecules of the high-k dielectric film.

5. (Currently Amended) The etching apparatus according to claim 4, wherein the stage holds the substrate in ~~an~~ a gaseous ambient including oxygen.

6. (Currently Amended) The etching apparatus according to claim 4, wherein the second ultraviolet radiating units radiate ultraviolet light having energy higher than binding energy of constituent molecules of the high-k dielectric film.

7. (Withdrawn) A wet etching method comprising:

irradiating a film to be etched and on a substrate with ultraviolet light having a wavelength not exceeding 200 nm;

applying a coating of a chemical solution to the film after irradiating the film with ultraviolet light having a wavelength not exceeding 200 nm; and

irradiating with the film through the chemical solution with ultraviolet light having a wavelength longer than 200 nm.

8. (Withdrawn) The wet etching method according to claim 7, including irradiating the film with the ultraviolet light having a wavelength not exceeding 200 nm in an ambient including oxygen to generate oxygen radicals and ozone proximate the film.

9. (Withdrawn) The wet etching method according to claim 8, wherein an organic coating formed on a surface of the film is removed by the oxygen radicals and ozone.

10. (Withdrawn) The wet etching method according to claim 7, including irradiating the film with the ultraviolet light having a wavelength longer than 200 nm and having energy higher than binding energy of constituent molecules of the film.

11. (Withdrawn) A method of manufacturing a semiconductor device, comprising:

forming a high-k dielectric film on a substrate;

forming a gate electrode on the high-k dielectric film;

irradiating the high-k dielectric film with ultraviolet light having a wavelength not exceeding 200 nm;

applying a coating of a chemical solution to the high-k dielectric film after irradiating with the ultraviolet light having a wavelength not exceeding 200 nm;
irradiating the high-k dielectric film, through the chemical solution, with ultraviolet light having a wavelength longer than 200 nm; and
forming diffusion regions in the substrate after irradiating with the ultraviolet light having a wavelength longer than 200 nm.

12. (Withdrawn) The method of manufacturing a semiconductor device according to claim 11, including irradiating the high-k dielectric film with the ultraviolet light having a wavelength not exceeding 200 nm in an ambient including oxygen to generate oxygen radicals and ozone proximate the high-k dielectric film.

13. (Withdrawn) The method of manufacturing a semiconductor device according to claim 12, wherein an organic coating formed on a surface of the high-k dielectric film is removed by the oxygen radicals and ozone.

14. (Withdrawn) The method of manufacturing a semiconductor device according to claim 11, including the irradiating the high-k dielectric film with the ultraviolet light having a wavelength longer than 200 nm and having energy higher than binding energy of constituent molecules of the high-k dielectric film.

15. (New) A wet etching apparatus comprising:
a stage for holding and rotating a substrate;
a nozzle for supplying a liquid to a substrate mounted on the stage;
a lamp housing disposed opposite the stage and including a window transparent to ultraviolet light disposed opposite a substrate mounted on the stage; and
first and second ultraviolet radiating units located within the lamp housing,
wherein

the first ultraviolet radiating unit radiates ultraviolet light having a wavelength not exceeding 200 nm for irradiating a substrate mounted on the stage, and

the second ultraviolet radiating unit radiates ultraviolet light having a wavelength longer 200 nm for irradiating a substrate mounted on the stage, and

the first and second ultraviolet radiating units are independently operable for radiating ultraviolet light.

16. (New) The etching apparatus according to claim 15, wherein the lamp housing is closed and filled with an inert gas.

17. (New) The etching apparatus according to claim 14, further including drive means for moving the lamp housing transverse to the stage, closer to and farther from a substrate mounted on the stage.